

WHAT IS CLAIMED IS:

1. A vibration element for a vibration wave driving apparatus, comprising:

a first elastic member;

5 a second elastic member;

an electro-mechanical energy conversion element that is disposed between the first elastic member and the second elastic member; and

10 a third elastic member that is disposed between the first elastic member and the electro-mechanical energy conversion element and has a large diameter than that of the electro-mechanical energy conversion element,

15 wherein when a driving signal is applied to the electro-mechanical energy conversion element, a first travelling wave is excited at a frictional surface of the third elastic member by bending vibrations which are displaced in a direction orthogonal to axial direction of the vibration element and a second  
20 travelling wave is also excited at the frictional surface by out-of-plane bending vibrations of the third elastic member.

2. A vibration element according to claim 1,  
25 wherein the driving signal applied to the electro-mechanical energy conversion element is used for exciting the bending vibrations which are displaced in

a direction orthgonal to axial direction of the vibration element.

3. A vibration element for a vibration wave  
5 driving apparatus, comprising:

a first elastic member;

a second elastic member;

an electro-mechanical energy conversion element  
that is disposed between the first elastic member and  
10 the second elastic member; and

a third elastic member that is disposed between  
the first elastic member and the second elastic member  
and has a larger outer diameter than that of the  
electro-mechanical energy conversion element,

15 wherein the third elastic member is disposed in a  
position that does not allow a center portion of the  
third elastic member in an axial direction of the  
vibration element to coincide with a center of an anti-  
node of a bending vibrations which are displaced in a  
20 direction orthogonal to the axial direction.

4. A vibration element for a vibration wave  
driving apparatus, comprising:

a first elastic member;

25 a second elastic member;

an electro-mechanical energy conversion element  
that is disposed between the first elastic member and

the second elastic member; and

a third elastic member that is disposed between  
the first elastic member and the second elastic member,  
in which an out-of-plane bending vibration in a plane  
orthogonal to an axial direction of the first elastic  
member and the second elastic member is excited by a  
bending vibrations which are displaced in a direction  
orthogonal to the axial direction.

5. A vibration element according to claim 1,  
wherein the first elastic member and the third elastic  
member are formed integrally.

6. A vibration element according to claim 3,  
wherein the first elastic member and the third elastic  
member are formed integrally.

7. A vibration element according to claim 4,  
wherein the first elastic member and the third elastic  
member are formed integrally.

8. A vibration wave driving apparatus,  
comprising:

a vibration element including a third elastic  
member and an electro-mechanical energy conversion  
element that are disposed between a first elastic  
member and a second elastic member; and

a rotor that is brought into contact with a frictional surface of the third elastic member,

wherein when a driving signal is applied to the electro-mechanical energy conversion element, the vibration element excites a first travelling wave at the frictional surface by a bending vibrations which are displaced in a direction orthogonal to an axial direction of the vibration element and a second travelling wave at the frictional surface by an out-of-plane bending vibrations of the third elastic member, and a circular or an elliptical movements is produced at the frictional surface by a vibration wave as a composite of the first travelling wave and the second travelling wave.

9. A vibration element according to claim 8, wherein the driving signal applied to the electro-mechanical energy conversion element is used for exciting the bending vibrations which are displaced in a direction orthogonal to axial direction of the vibration element.

10. A vibration wave driving apparatus, comprising:

a vibration element including an electro-mechanical energy conversion element and a third elastic member that are disposed between a first

elastic member and a second elastic member, the third elastic member having a frictional surface and a larger outer diameter than that of the electro-mechanical energy conversion element; and

5 a rotor that is brought into contact with the frictional surface of the vibration element,

wherein the vibration element excites a bending vibrations which are displaced in a direction orthogonal to an axial direction of the first elastic member and the second elastic member through application of a driving signal to the electro-mechanical energy conversion element, and

10 a center of an anti-node of the bending vibration does not coincide with a center portion of the third elastic member in an axial direction of the vibration element.

11. A vibration wave driving apparatus, comprising:

20 a vibration element including an electro-mechanical energy conversion element and a third elastic member that are disposed between a first elastic member and a second elastic member; and

a rotor that is brought into contact with a frictional surface of the vibration element,

25 wherein the vibration element excites an out-of-plane bending vibration in a plane orthogonal to an

axial direction of the vibration element in the third elastic member by a bending vibrations which are displaced in a direction orthogonal to the axial direction.

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12. A vibration wave driving apparatus,  
comprising:

a vibration element including:

an electro-mechanical energy conversion element;

10 a third elastic member that extends in a direction orthogonal to an axial direction of the vibration wave driving apparatus and has a frictional surface on its outer peripheral side with respect to the electro-mechanical energy conversion element;

15 a first elastic member that extends in the axial direction of the vibration wave driving apparatus from a surface having the frictional surface of the third elastic member;

a second elastic member; and

20 a rotor that is brought into contact with the frictional surface of the vibration element,

wherein when a plurality of driving signals that are different in phase are applied to the electro-mechanical energy conversion element, the vibration  
25 element excites a plurality of bending vibrations which are displaced in a direction orthogonal to an axis of the vibration element to produce a first travelling

wave at the frictional surface and excites a bending vibration in an out-of-plane direction of the third elastic member to produce a second travelling wave at the frictional surface.

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13. A vibration wave driving apparatus according to claim 12, wherein the electro-mechanical energy conversion element is disposed on an opposite side to the first elastic member with the third elastic member interposed therebetween.

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14. A vibration wave driving apparatus according to claim 8, wherein a center portion in the axial direction of the third elastic member does not coincide with a center of an anti-node of the bending vibrations which are displaced in a direction orthogonal to the axial direction of the vibration element.

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15. A vibration wave driving apparatus according to claim 11, wherein a center portion in the axial direction of the third elastic member does not coincide with a center of an anti-node of the bending vibrations which are displaced in a direction orthogonal to the axial direction of the vibration element.

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16. A vibration wave driving apparatus according to claim 12, wherein a center portion in the axial

direction of the third elastic member does not coincide with a center of an anti-node of the bending vibrations which are displaced in a direction orthogonal to the axial direction of the vibration element.

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17. A vibration wave driving apparatus according to claim 8, wherein the first elastic member and the third elastic member are formed integrally.

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18. A vibration wave driving apparatus according to claim 10, wherein the first elastic member and the third elastic member are formed integrally.

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19. A vibration wave driving apparatus according to claim 11, wherein the first elastic member and the third elastic member are formed integrally.

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20. A vibration wave driving apparatus according to claim 12, wherein the first elastic member and the third elastic member are formed integrally.

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21. A vibration wave driving apparatus according to claim 8, wherein at least one of end portions of the vibration element has an increased diameter.

22. A vibration wave driving apparatus according to claim 10, wherein at least one of end portions of



the vibration element has an increased diameter.

23. A vibration wave driving apparatus according  
to claim 11, wherein at least one of end portions of  
5 the vibration element has an increased diameter.

24. A vibration wave driving apparatus according  
to claim 12, wherein at least one of end portions of  
the vibration element has an increased diameter.

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25. A vibration wave driving apparatus according  
to claim 8, wherein the third elastic member includes a  
thinner portion than a portion at which the frictional  
surface is located, on an inner peripheral side with  
15 respect to the frictional surface.

26. A vibration wave driving apparatus according  
to claim 10, wherein the third elastic member includes  
a thinner portion than a portion at which the  
20 frictional surface is located, on an inner peripheral  
side with respect to the frictional surface.

27. A vibration wave driving apparatus according  
to claim 11, wherein the third elastic member includes  
25 a thinner portion than a portion at which the  
frictional surface is located, on an inner peripheral  
side with respect to the frictional surface.

28. A vibration wave driving apparatus according to claim 12, wherein the third elastic member includes a thinner portion than a portion at which the frictional surface is located, on an inner peripheral side with respect to the frictional surface.

29. A vibration wave driving apparatus according to claim 8, wherein the vibration element further includes another electro-mechanical energy conversion element that is fixed to the third elastic member.

30. A vibration wave driving apparatus according to claim 10, wherein the vibration element further includes another electro-mechanical energy conversion element that is fixed to the third elastic member.

31. A vibration wave driving apparatus according to claim 11, wherein the vibration element further includes another electro-mechanical energy conversion element that is fixed to the third elastic member.

32. A vibration wave driving apparatus according to claim 12, wherein the vibration element further includes another electro-mechanical energy conversion element that is fixed to the third elastic member.